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Consumer Acceptance of Florida Oranges With and Without Color Added

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PREFACE

This report compares sales of Florida oranges with color added and those in their natural state, and also examines consumer attitudes toward these two products. The economic implications of offering consumers natural-color Florida oranges only are appraised.

The study is part of a broad program of research to provide information for marketing groups and farmers, and to evaluate merchandising programs designed to expand the demand for agricultural products and increase marketing efficiency.

The Florida Citrus Commission cooperated in this study by arranging for the supply of test fruit and assisting in obtaining the cooperation of the retail food outlets used in the test.

Special acknowledgment is extended to the management and store personnel of the Kroger Company of Cleveland, Ohio, and Penn Fruit Company of Philadelphia, Pa., for their cooperation in making their stores and other facilities available. Particular thanks go also to William Black of the Florida Citrus Commission and John Lesley of the Florida Citrus Exchange for their suggestions in planning the study and arranging for the supply of fresh test fruit.

The study was conducted under the general direction of Robert E. Frye and Trienah Meyers. James L. Hannan aided in establishing analytical procedures and supervising work on the combined analysis.

Nick Havas and Michael Van Dress were responsible for the sales test; Harold Linstrom and Pauline Kartalos were in charge of the point-of-purchase interviews.

May 1962

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SUMMARY

Highlights

Sales of Florida oranges decreased significantly in the Cleveland market--which is perhaps typical of the Midwest--when consumers were offered Florida oranges in natural color only. On the other hand, in Philadelphia, a representative eastern market, sales remained about the same whether natural-color or color-added oranges were offered.

When oranges with and without color added were displayed side by side, total sales of Florida oranges were 36 percent greater in Cleveland and 20 percent greater in Philadelphia than average sales of either type displayed alone. The size and location of test displays were held constant. Furthermore, the sales increase of test oranges had no measurable effect on sales of related commodities such as orange juices, fresh grapefruit, and nontest fresh oranges.

Sales of color-added Florida oranges exceeded natural-color in Cleveland during each test period whether displayed alone or in combination. When each type of test fruit was displayed alone, sales favored the color-added oranges by 15 percent in the first experiment, 30 percent in the second, and 17 percent in the third. The average ratio of sales for the 3 periods was 5 to 4 in favor of the artificially colored fruit. When displayed in combination, sales of color-added fruit were even more favorable or almost twice the volume of natural-color oranges.

In Philadelphia, sales were almost equal for the two types of fruit whether offered alone or in combination.

These are among the results of three controlled experiments, each of 3 weeks' duration, conducted in retail food supermarkets in Cleveland and Philadelphia during November-December 1959 and 1960 and in June 1961. Point-of-purchase interviews with buyers of test oranges were conducted during the final week of each 3-week experiment.

Of nearly 2,400 orange buyers interviewed at point-of-purchase during several experimental periods, over 70 percent said they knew color was sometimes added to the surface of oranges.

Of the shoppers making unmixed purchases, about 6 in 10 selected the color-added fruit and 4 in 10 the natural.

Purchasers of the natural-color fruit, in both cities, tended to be more critical of the color-added fruit than were the buyers of color-added oranges of the natural-color oranges. However, in all three experimental periods, a sizable majority of the shoppers interviewed said they would have bought the juice-type orange on the day of the interview regardless of whether it had color added or not. This indicates that even though some buyers disapprove of the practice of adding color to oranges, their attitude is tempered by the belief that the color is only on the skin and will not affect the eating quality of the fruit.

Conclusions

In projecting the results of this study to markets other than the test cities, it is necessary to consider factors affecting the sales results obtained.

First, it should be recognized that the results reported here represent consumers' initial reaction during a relatively short period. The degree of acceptance of natural-color oranges in other marketing areas will undoubtedly vary, but the findings may be utilized in appraising demand for natural-color oranges in marketing areas with similar characteristics.

Second, test cities were selected to represent two distinctly different marketing situations. In Cleveland, consumers had not been generally exposed to natural-color Florida oranges. It is probable that the preference for artificially colored fruit in Cleveland would not be as distinct if natural-color oranges were offered over a period of time. This is based on the assumption that over time consumers will learn by experience that exterior appearance of the natural-color orange is not necessarily related to its interior quality. For instance, in Philadelphia, where consumers were generally exposed to natural-color oranges, sales were nearly alike for the two types of fruit. A well directed advertising and educational program might speed acceptance of natural-color oranges in markets like Cleveland.

Third, another factor to be considered is the variation in natural color between crop years, and between varieties within a crop year. There are some indications that consumer sales resistance could become more pronounced as the contrast in color becomes greater between natural-color oranges and the color image consumers associate with ripe oranges. Note the color plate opposite page 4 which shows the color of fruit used in this experiment.

CONSUMER ACCEPTANCE OF FLORIDA ORANGES WITH AND WITHOUT COLOR ADDED

By Nick Havas, Michael G. Van Dress, Harold R. Linstrom, and Pauline Kartalos 1/

BACKGROUND AND OBJECTIVES

Nearly 21 million boxes of Florida oranges were sold for fresh consumption during the crop year 1960-61. This represented almost 23 percent of Florida's commercial production and brought approximately 42 million dollars to growers. About two-thirds of the oranges sold each year for fresh consumption are put through a coloring process to obtain a more uniformly orange color. The cost of adding color is estimated to be approximately 5 cents per box. On this basis, it cost the Florida citrus industry nearly $750,000 to color oranges during the 1960-61 season.

The volume of Florida oranges subjected to the color-add process is heavier during the first and last part of each season. However, depending on weather conditions, the color-add process is utilized by some shippers throughout the harvest season to obtain more uniformity in orange color and possibly a higher percentage of marketable fruit.

During the early weeks of the crop season, Florida oranges generally reach maturity in respect to sugar content and fruit solids before the surface area of the fruit is fully colored. In later weeks, a physiological process causes the fruit of late season varieties to regreen after it has matured and attained good orange color. Regreening reportedly is caused by a return of growing conditions favorable to abundant production of chlorophyll. It is generally most noticeable during May and June.

About one-third of the Florida oranges marketed for fresh consumption is sold in its natural-color state. The bulk of this fruit is moved through major markets in eastern States, while midwestern outlets receive primarily color-added fruit.

Florida oranges colored artificially are required by law to be labeled "color-added." The adding of color to oranges is not to affect quality but to make them visibly more attractive to buyers. If shipped interstate, fruit with color added must meet more stringent minimum requirements with respect to soluble solids, citric acid, and juice content than fruit of natural color. For example, the Florida citrus code requires that color-added oranges yield a minimum of 5 gallons of juice per standard box, whereas for natural-color the minimum is 4½ gallons.

1/ Mr. Havas and Mr. Van Dress are in the Marketing Economics Division, Economic Research Service; Mr. Linstrom and Miss Kartalos are in the Standards and Research Division, Statistical Reporting Service.

Although the present method of coloring Florida oranges has been practiced for over 25 years, the role of orange coloring and its effect on consumer buying has not been appraised fully. Some members of the industry would prefer to market fruit in its natural state if consumers would buy as many of them as of the others. Furthermore, discontinuance of coloring would decrease packinghouse costs.

The problems of coloring oranges are further complicated by recent legislation concerning the use of additives in food products. Red No. 2, the material now used in coloring oranges, is on the provisional list of commercially permissible color additives (Public Law 86-218, enacted July 12, 1960). A period of 2½ years is provided in which to complete scientific investigations as to the safety of this material. If Red No. 2 is approved, the immediate problem of having a safe coloring agent for oranges will be solved. However, information as to how coloring of oranges affects buying decisions will continue to be vital to the Florida citrus industry in making basic marketing decisions.

The objectives of this research were to: (1) Determine comparative consumer acceptance of color-added and natural-color Florida oranges as reflected by sales under normal retail operating conditions; (2) weigh the opinions of homemakers who had purchased either color-added or natural-color oranges; and (3) explore possible limitations of the market for Florida oranges if they are offered to consumers in natural color only.

PROCEDURE

The study was conducted in selected retail supermarkets in two cities. Cleveland, Ohio, was selected to represent reactions of consumers to natural-color Florida oranges in markets which sell Florida oranges predominantly with color added. Philadelphia, Pa., was chosen to reflect eastern markets, through which most natural-color Florida oranges are distributed.

Controlled experiments were conducted under normal retail conditions using centrally managed chain outlets in each city to minimize effects of different merchandising policies on sales of the test fruit. In Cleveland, the same 15 stores were used in each experiment. During the first experiment in Philadelphia, nine supermarkets were used. Six of these nine supermarkets were used in both the second and third experiments.

The overall study consisted of three experiments, each of 3 weeks' duration. Experiments I and II were conducted in November and December of 1959 and 1960 using the Hamlin variety of oranges. The third experiment was undertaken in June 1961 using Valencia oranges.

A latin square experimental design was used to assign treatments to stores and time periods in both cities (table 1). During any given week, consumers were given a choice of one of three purchasing alternatives in each store--natural-color Florida oranges only, color-added only, or a combination display of both types. Each method tested was in one-third of the test stores in each

Table 1.--Schedule of displays of Florida oranges with and without color added, in selected stores in Philadelphia, Pa., and Cleveland, Ohio 1/

City and store number	First week	Second week	Third week
Philadelphia: 2/			
1	A	C	B
2	B	A	C
3	C	B	A
4	B	A	C
5	C	B	A
6	A	C	B
7	C	B	A
8	A	C	B
9	B	A	C
Cleveland: 3/			
1	A	C	B
2	C	B	A
3	B	A	C
4	A	C	B
5	B	A	C
6	C	B	A
7	C	A	B
8	A	B	C
9	B	C	A
10	B	A	C
11	C	B	A
12	A	C	B
13	B	C	A
14	A	B	C
15	C	A	B

1/ A - Color added, B - natural color, C - combination of A and B.

2/ Tests were made December 7 to 28, 1959; November 15 to 21 and November 29 to December 12, 1960; and June 12 to July 1, 1961. All 9 stores were used in 1959; stores 4 through 9 were used in 1960 and 1961.

3/ Tests were made November 23 to December 12, 1959; November 14 to December 3, 1960; and June 13 to July 1, 1961.

city during every week of each 3-week period. Use of this type of experimental design equalizes effects on sales resulting from time and store differences.

Prices were identical in all stores within each city for like sizes of natural-color and color-added oranges in any specific week of the experiment. But prices did vary among the three experimental periods as well as between weeks on occasions. These price changes, however, were made effective in all test stores in each city simultaneously, thereby equalizing the effect on all treatments.

In each store, the size of display for test oranges was the same for the three methods tested. Weekly sales data were obtained for test fruit through store audits. Sales information was recorded also for other related or possibly substitute items, such as fresh grapefruit and nontest oranges, as well as canned single-strength and concentrated and fresh-squeezed orange juice. Pricing and displaying of these items were left to the discretion of the cooperating chain. Efforts were made, however, to have the same substitute items and prices in all test stores in each city. When changes occurred, they were made in all test stores simultaneously.

The color contrast between the natural and color-added Hamlin oranges used in the 1960 test is shown in figure 1A, facing page. The color contrast of test fruit in 1959 was of similar nature but slightly less pronounced. Based on appearance alone, the quality of the test fruit was not so good in 1960 as in 1959. The degree of color contrast for the Valencia orange is shown in figure 1B. The appearance of the Valencia was considered less appealing than the Hamlin.

To insure comparable quality of the test fruit in each city, oranges were of the same U. S. Grade and, to the extent possible, from the same grove for each experiment.

Test oranges used in the Cleveland market during the first week of Experiment I were size 200. The 252 size was used during the remaining 2 weeks. 2/ In Experiment II, size 252 was used during the entire test. During Experiment III, size 200 was used.

In Philadelphia, each store displayed 2 sizes of oranges ranging from 163 to 252. With one exception, these sizes were continuously stocked throughout each test. The exception was in Experiment III, when only one size orange was offered in stores with the combination display treatment.

During each of the three experiments--November-December 1959, November-December 1960, and June-July 1961--interviewers were stationed at the orange displays to record the type and size of each purchase of Florida oranges, and to question everyone who purchased the test fruit to determine his or her awareness of color addition in general, opinion of the practice, and likes and dislikes regarding these two types of oranges.

2/ The fruit sizes represent full box count.

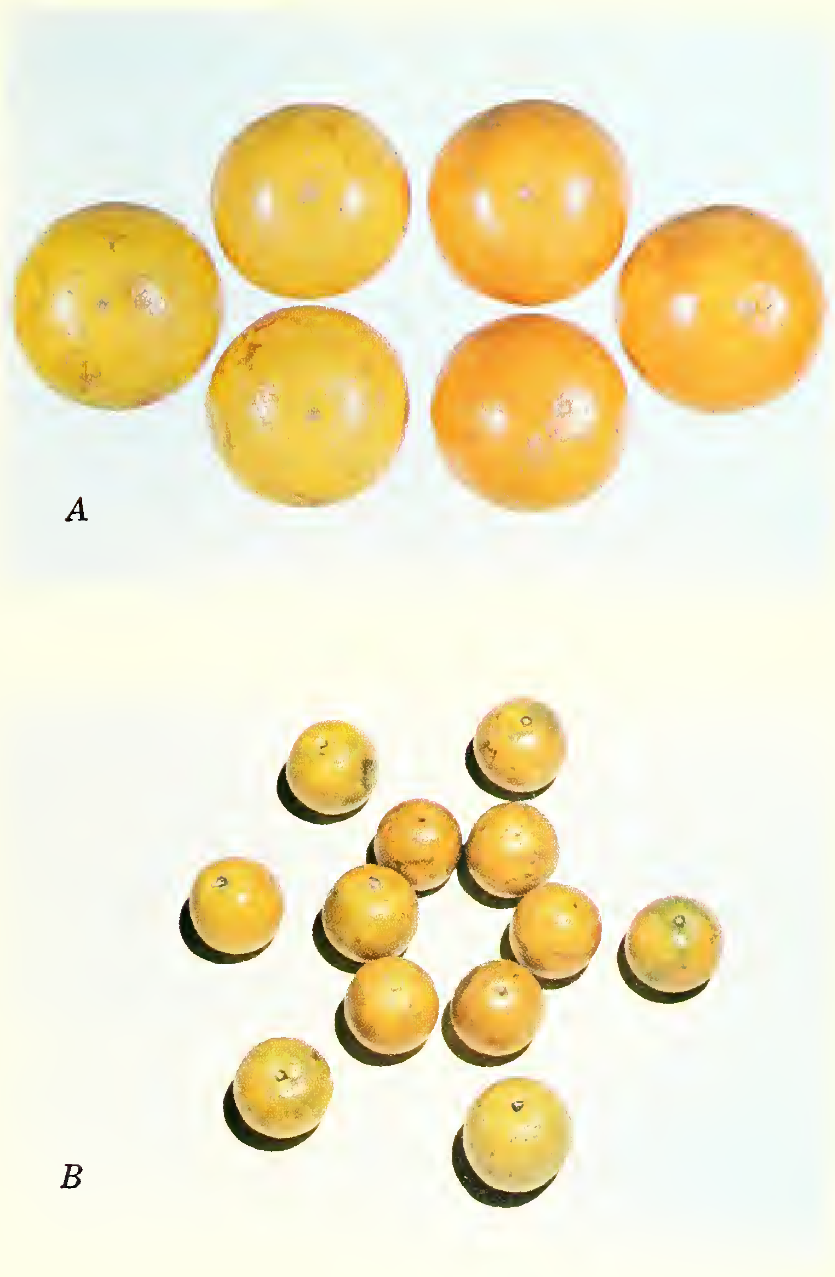

Figure 1.--Color contrast of oranges used in test with and without color added: A--Hamlin variety; B--Valencia variety.

To minimize effects on experimental sales, interviews were conducted only during the last week of each test period.

FINDINGS

Sales

Consumer reaction to Florida oranges with and without color added was significantly different in the two test cities but was consistent for the three experiments in each city. In Cleveland, sales of color-added oranges were consistently greater than those of natural-color. On the other hand, consumers in Philadelphia showed approximately equal acceptance for both types of oranges. In both test cities, sales from the combination display of oranges with and without color added were significantly greater than from displays having only one of the two types of test oranges, except for the third experiment in Philadelphia when sales were about equal. In that experiment, only one size of orange was offered in the combination display while two sizes were offered in the other experiments.

Cleveland

Aggregate sales data for the three experiments were analyzed to appraise the demand for Florida oranges in the Cleveland market when offered in natural color, with color added, and in combination. Results showed that Florida orange sales were 20 percent less when offered in natural color instead of with color added. This difference is statistically significant at the 5-percent probability level. 3/ The sales ratio was 5 to 4 in favor of the color-added oranges when each type of test fruit was displayed alone, and 2 to 1 when displayed side by side.

In Cleveland, consumers preferred the color-added Florida oranges in all three experiments whether displayed alone or in combination (table 2). There was variation in the degree of preference for color-added fruit among experiments but this was to be expected as the degree of color contrast between color-added and natural-color test fruit was not constant.

When the oranges with and without color added were displayed side by side using the same total display area as in the other treatments, combined sales were about 36 percent greater than average sales of each type displayed alone. The difference is statistically significant at the 1-percent probability level. The combination displays resulted in increased sales in all three experiments (table 2). The fact that consumers in Cleveland bought more Florida oranges when stores displayed both types of test fruit confirms a commonly accepted merchandising principle that sales increase when consumers are offered greater

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3/ The probability is only 5 in 100 that sales differences of this magnitude would have been obtained from chance variation in sales.

Table 2.--Sales of Florida oranges, 3 test methods of display, and percentage changes in sales, Cleveland and Philadelphia

City and test period	Sales, by test methods 1/				Percentage change		
	A	B	Average A and B	C	B (A= 100%)	C (A= 100%)	C (Av. A and B =100%)
	Pounds	Pounds	Pounds	Pounds	Percent	Percent	Percent
Cleveland:							
1959, fall........	17,402	14,874	16,138	23,189	-15	+33	+44
1960, fall........	12,372	8,671	10,522	13,254	-30	+7	+26
1961, spring......	4,165	3,443	3,804	5,066	-17	+22	+33
Total...........	33,939	26,988	30,464	41,509	-20	+22	+36*
Philadelphia:							
1959, fall........	21,156	20,601	20,878	25,820	-2.6	+22.0	+24
1960, fall........	8,080	8,360	8,220	10,445	+3.5	+29.3	+27
1961, spring......	6,365	6,245	6,305	2/6,340	-1.9	-.4	+.6
Total...........	35,601	35,206	35,404	42,605	-11	+20	+20*

1/ A - Color added, B - natural color, C - combination of A and B.

2/ Only one size of fruit was on test; there were two sizes in the 1959 and 1960 tests.

*Significant difference at the 1-percent probability level.

variety. 4/ These findings indicate also that some consumers' preference for either the color-added or natural-color fruit may be strong enough to forego purchases when their choice is not available.

Philadelphia

Aggregated data for the three experiments in Philadelphia show no significant difference in sales of color-added and natural-color Florida oranges whether displayed alone or in combination. However, when oranges with and without color added were displayed together, total sales were 20 percent greater than sales of either kind when offered alone. This difference is significant at the 1-percent probability level.

4/ Smith, H. M., and Havas, Nick. Displaying Dates in Packages of Different Sizes. U. S. Agr. Mktg. Serv., AMS-349, 11 pp. Nov. 1959.

Smith, H. M., Clement, W. E., and Hoofnagle, W. S. Merchandising Winter Pears in Retail Food Stores. U. S. Dept. Agr., Mktg. Res. Rpt. 102, 17 pp. Sept. 1955.

The results of each experiment revealed that consumers did not have a strong preference in favor of color-added or natural-color, and if Florida oranges were marketed in natural color only, demand would remain about the same (table 2). However, if both kinds were offered consumers, significant increases in sales would be expected.

Variation in Sales of Test Oranges

The variation in sales among the three experiments within each city may be attributed to price differentials and seasonality differences. The prices of the test oranges were lowest during the fall of 1959 and highest in the spring of 1961 with 1960 about mid-way of the two extremes. In addition to the price differentials, the experiment in 1961 was conducted during the last 3 weeks of June, seasonally a low sales period for Florida oranges.

In Philadelphia, in addition to price differentials and seasonality differences among experimental periods, there were differences in the number of test stores used. Nine stores were used in 1959 and six in 1960 and 1961.

Related Commodities

Sales of related commodities such as tangerines, tangelos, nontest oranges, and grapefruit as well as canned single-strength, frozen concentrated, and fresh-squeezed orange juices were recorded for the purpose of observing changes in sales during test weeks. These supplementary data were used to appraise the degree of substitution, if any, between related products and sales of test fruit.

Sales of related commodities in the Cleveland stores were fairly consistent for all treatments. In Philadelphia some variation in sales was noted for fresh nontest citrus but differences were not found to be statistically significant (table 3). The test fruit did not measurably affect sales of related products.

Point-of-Purchase Interviews

This portion of the study represents two aspects of shoppers' buying habits; the first is the preknowledge stage when the item to be purchased attracts the buyer through its own appeal to the senses; the second is when purchasers are exposed to additional knowledge and attitudes are probed afterward. Cleveland was selected as representative of a city where color-added oranges sold well. Natural-color oranges were better known in the Philadelphia market. In both cities, everyone who was observed purchasing either or both types of test oranges during the selected periods was interviewed. Appendix tables 4 and 5 indicate the personal characteristics of these shoppers.

Throughout all experiments, Cleveland shoppers remained consistent in being favorably disposed toward color-added oranges. Of the total buyers interviewed in Cleveland, 906 bought color-added oranges and 420 the natural-color fruit. In Philadelphia, 519 shoppers bought those with color added and

Table 3.--Sales of grapefruit, nontest oranges, and juices in Florida-orange color study, 3 test methods of display, Cleveland and Philadelphia

Year and test method 1/	Cleveland			Phildelphia		
	Grapefruit	Nontest oranges 2/	Juices	Grapefruit	Nontest oranges 2/	Juices
	Pounds	Pounds	Quarts 3/	Pounds	Pounds	Quarts 3/
1959, fall:						
A	20,026	35,881	13,336	27,097	18,812	35,496
B	20,931	33,921	13,574	28,274	21,162	34,098
C	18,246	33,358	14,980	26,888	19,351	32,383
Total	59,203	103,160	41,890	82,259	59,325	101,977
1960, fall:						
A	18,034	8,882	15,281	8,995	7,271	8,576
B	16,847	8,049	15,475	6,921	6,245	7,799
C	17,201	8,133	16,450	6,443	4,245	7,584
Total	52,082	25,064	47,206	22,359	17,761	23,959
1961, spring:						
A	3,697	4,579	12,221	4,680	3,433	8,659
B	4,426	4,207	11,275	3,955	3,870	8,247
C	4,269	5,005	13,445	3,000	2,808	8,038
Total	12,392	13,791	36,941	11,635	10,111	24,944

1/ A - Color added, B - natural color, C - combination of A and B.
2/ Includes tangerines and tangelos.
3/ Frozen juices converted to the reconstituted quivalent.

518 chose the natural. These almost identical totals resulted in spite of a slight trend, over the three experiments, away from the natural-color oranges. One explanation for this may have been the fact that the test oranges (especially in the second experiment) were unusually pale in their natural state.

Awareness of Natural-Color and Color-Added Fruit in Combination Display

In the stores the interviewers observed the shopper selections made from combination displays. The two types of oranges were given equal space and the color-added oranges were stamped as such. After the shopper had selected a type of orange, she was asked if she had noticed the other type orange included in the display.

Fewer shoppers in Cleveland than in Philadelphia noticed the "other" test orange. Those who selected the color-added oranges were less likely to notice a difference than those who purchased the natural fruit. In Cleveland, shoppers who selected both types often did not notice that there was a difference (table 6).

Reasons for Selection

Cleveland shoppers who were aware that both types of oranges were on display, but purchased the color-added fruit, said that they "looked better, juicier, and sweeter." This seems to indicate that when the outside of the orange is aesthetically pleasing, the inside is expected to be better. Some of the buyers of natural color fruit in Cleveland said that they did not like color additives (table 7). A few shoppers who, in the same purchase, chose from both types of oranges said they wanted to make comparisons. Regardless of which type of orange was selected, Philadelphia shoppers indicated that looks were most important to them. A number of shoppers in both cities said that the oranges they chose were simply "close at hand," indicating either that they were unaware of the two types on display or that it made no difference to them which they bought.

Reasons for Rejection

Respondents who criticized the natural-color oranges spoke of their pale color, while those who purchased natural-color oranges in spite of the pale color disliked the fact that the other oranges were artificially colored. Some respondents who had purchased the natural-color oranges objected to the color additive as potentially harmful or deceiving, but others felt that responsible authorities would have stopped its use if the additive were harmful. Only one-fourth of the buyers of color-added oranges criticized the practice of adding color to oranges. A greater proportion, nearly 50 percent, of the shoppers who bought natural color oranges were critical of coloring. The purchasers of the artificially colored oranges leaned toward the aesthetic values, and toward speculation about what the inside of the orange would be like, amount of juice, etc.

Convenience Packaging

In Cleveland, the city in which there was a choice between bulk (loose) and prepackaged oranges, about two out of three shoppers selected the prepackaged fruit (table 8). This was especially noticeable in the first two experiments. In the third experiment the ratio of bag to bulk purchase was nearer 1 to 1.

Recent Purchase of "Other" Oranges

When shoppers were asked if they had recently bought oranges other than their present selection, it was with the understanding that both types of oranges had been in the stores for several weeks, and that respondents who had purchased oranges at least once in the past month would have been exposed to oranges with and without color added. In Experiment II only 17 percent of purchasers of oranges with color added in Cleveland had recently bought natural-color fruit. This was the lowest purchase rate for the "other" type of orange in either city during any phase of the survey. Throughout the tests, the Cleveland buyers of color-added oranges and the Philadelphia shoppers who selected the natural-color fruit followed the tradition of those cities; that is, they said they avoided buying the "other" group of oranges (table 6).

Willingness to Buy "Other" Oranges

An important aim of the interview was to discover shoppers' willingness to buy oranges other than the ones purchased. None of the shoppers in either city during these experiments expressed a great resistance to buying the non-preferred type. The proportion saying that they would have purchased the other type of orange if their choice were not available ranged from 6 to over 8 out of 10 respondents (table 6).

Knowledge of the Color-Add Practice

Up to this point in the interview, there were no specific questions in regard to the color-add process. This topic was discussed only if the respondent brought it up in her "reasons for selection." After the reasons were fully documented, the respondent was asked, "Do you happen to know whether or not color is sometimes added to the outside of oranges?" Over 7 out of 10 people in both cities during each experiment said that they knew color was added to oranges (table 6).

Attitudes Toward the Color-Add Practice

Once color addition was introduced into the interview, information was sought concerning attitudes about the subject. The question was asked, "... do you think it (color being added)...is a good idea, a bad idea, or doesn't it make any difference to you?" This question was asked of everyone including those who said "No" or "Don't know" to the previous question on their knowledge of the color-add practice. Through the duration of the study, nearly half the buyers interviewed said that it made no difference to them whether color was added or not. Of the remaining respondents, those who selected the natural-color fruit were more critical of the color-add practice than those who had selected the color-added oranges.

Reasons for Attitudes

Orange buyers participating in the test were asked about the reasoning behind their expressed feeling on color addition. The majority of those who said the addition of color was a good idea felt that this gave the orange a better appearance. Others said it was good for merchandising and made the oranges look riper.

Those who objected to the color-add practice were more likely to have purchased the natural-color fruit. They were most concerned about its possible harm to the consumer ("Not good for you"; "Might cause illness"). Others said that color addition is misleading; that the external coloring covers up defects in the fruit, or enables the seller to pass off unripe oranges as ripe.

Those who said it made no difference to them whether color was added or not were convinced that the additive had no effect on the meat or flavor of the orange. Others were unconcerned because they felt that color would not be used if it were harmful or potentially harmful to the consumer.

APPENDIX

Methodology

This study, designed to evaluate the comparative consumer acceptance of natural-color and color-added Florida oranges using retail sales as an index, was conducted in 3 concurrent experiments in Cleveland, Ohio, and Philadelphia, Pa., during November-December 1959 and 1960 and June of 1961. Each experiment was of 3 weeks' duration.

In Cleveland, 15 stores were used during each phase. In Philadelphia, nine stores were used in the first test and six in the second and third tests. All stores were under central management. Consumers were offered three test treatments: natural-color oranges only, color-added only, and a combination of the two.

A 3 x 3 latin square design was used to assign the merchandising alternatives to time periods and test stores in each city. Each method was tested in one-third of the test stores every week of each 3-week period.

By rotating each method from store to store, the effect on sales due to differences in store size, seasonality in demand, and other nontest variables associated with stores and time periods were equalized. Nontest variables not inherently controlled by the test design, such as size and location of display, prices, advertising, and other merchandising policies which might have affected sales of the test fruit, were held constant within experimental stores.

Variance Analysis

Analysis of variance of the sales data was made for each test to determine the sales effect of the three test treatments. In addition, an analysis of variance of the three experiments combined was computed for each city (tables 9-14).

The overall analysis was used to isolate the effect on orange sales attributed to such additional sources of variation as differences between years and seasons (tables 15 and 16). The analysis of variance was used also to determine the association, if any, between sales of related products and the test fruit (table 17).

The "F" test was used to determine whether variations in sales among the treatment means were statistically significant. If a significant difference was indicated, the "least significant difference" test was employed to determine if a contrast of any two means was significant at an acceptable level. 5/

Because considerable control was exercised over the test product, 20 percent was selected as the probability level needed for statistical significance, while the 5-percent level was selected for related products.

The following paragraph gives a descriptive illustration of the meaning and usefulness of statistical significance and confidence levels associated with the statistical tests.

Statistical tests indicate the probability (odds) of findings sales differences (increases or decreases) such as those obtained between treatments as a result of experimental errors, (chance fluctuation in sales and errors of measurement in collecting data), if in fact the true differences between treatments had been zero. A difference in sales between two treatments is considered to be statistically significant with a high degree of confidence if the probability is 0.10 or less (0.05, 0.01, 0.005) that the difference is due to sampling error or chance variation. That is, if the odds that the sales difference were due to chance are low (10 in 100, 5 in 100), it is concluded that the differences are due to the influence of the treatments. The researcher may use a probability level of a greater magnitude (for example 0.20) in testing differences between treatments; however, less confidence is placed in the inference or conclusions drawn from such a test. For example, if the difference in sales between two treatments is found to be significant at the 0.01 probability level, the odds are 99 to 1 that the difference in sales is due to the differences in the effects of the treatments; but if the difference in sales is significant at the 0.10 probability level, the odds are 9 to 1 (90 to 10) that the difference is due to the treatment effects, and at the 0.20 probability level, the odds are only 4 to 1 (80 to 20). Thus, the findings of significance at the 0.10, 0.20, and higher probability levels should be used with greater reservation than when the 0.01 or 0.05 level is attained. 6/

5/ Hoel, P. G. Introduction to Mathematical Statistics. New York, John Wiley and Sons, 258 pp. 1947.

Snedecor, G. W. Statistical Methods. Ames, Iowa Univ. Press, 534 pp. 1956. Pp. 244-250.

6/ Henderson, P. L., Brown, S. E., and Hind, J. F. Sales Promotional Programs for Apples. U. S. Dept. Agr., Mktg. Res. Rpt. 446, 31 pp. Jan. 1961.

Questionnaire Used in Consumer Survey

SUGGESTED INTRODUCTION: Hello. I'm working on a study for the U.S. Dept. of Agriculture. We are interested in the oranges you just picked out and would like to ask you a few questions about them.

CHECK SHOPPER'S SELECTION

___natural ___bag
___colored ___bulk No. bought_____

(FROM OBSERVATION: ___male ___female)

1. First of all, did you notice this other group of oranges when you were making your choice?

___yes ___no - go to Q. 3

2. Why did you select the oranges you chose rather than the others?

____

____

____

3. How about the oranges you just chose--is there anything you don't like about them?

____

____

____

4. And the other group of oranges--is there anything (else) you don't like about them?

____

____

____

5. Have you bought this other kind recently?

___yes ___no

6. Let's suppose the store didn't have the oranges you chose. If that happened, do you think you would buy the others today or not?

_____would _____would not

7. Do you happen to know whether or not color is sometimes added to the outside of oranges?

___added ___not ___don't know

8. How (do)(would) you feel about color being added to the outside of oranges--do you think it's a good idea, a bad idea, or doesn't it make any difference to you?

___good ___bad ___no difference

9. Why do you feel this way?

____

____

____

10. How many times have you bought fresh oranges in the past four weeks?

___times per __________

Now we're almost finished, but I need to ask you just two questions about yourself so we'll have an overall picture of the shoppers we have talked to.

How old were you on your last birthday?

___under 35 ___35 to 49 ___50 or over

And what was the last grade of school you completed?

Grade school: ___some ___finished
High school : ___some ___finished
College : ___some ___finished

Thank you very much.

Table 4.--Percentage distribution of buyers in each experiment by background characteristics

Survey of consumer preferences for Florida oranges with and without color added

Characteristic	Cleveland						Philadelphia					
	Color-added			Natural			Color-added			Natural		
	1959	1960	1961	1959	1960	1961	1959	1960	1961	1959	1960	1961
Sex:												
Female............	76	72	61	68	66	78	69	70	72	76	67	69
Male..............	23	27	33	29	29	21	27	28	28	21	30	31
Not ascertained...	1	1	6	3	5	1	4	2	---	3	3	---
Age:												
Under 35 years....	31	31	22	22	24	26	26	30	24	25	31	22
35 to 49 years....	42	41	43	49	50	31	40	37	42	47	36	40
50 years and older	26	28	34	27	26	40	32	33	34	27	33	37
Not ascertained...	1	*	1	2	---	3	2	---	---	1	---	1
Education:												
Grade school......	20	15	17	11	13	24	15	24	20	16	17	27
High school.......	61	66	63	64	63	60	61	61	66	51	68	64
College...........	19	19	17	24	24	16	23	14	12	32	15	8
Not ascertained...	---	---	3	1	---	---	1	1	2	1	---	1
Number of respondents........	338	448	120	221	131	68	231	165	123	304	118	96

*Less than 1 percent.

Table 5.--Percentage distribution of buyers in each experiment by size and frequency of purchase

Survey of consumer preferences for Florida oranges with and without color added

Size and frequency of purchase	Cleveland						Philadelphia					
	Color-added			Natural			Color-added			Natural		
	1959	1960	1961	1959	1960	1961	1959	1960	1961	1959	1960	1961
Number of oranges bought:												
1-6...............	8	8	23	6	7	28	35	32	36	31	37	39
7-12..............	86	35	74	87	41	67	56	63	59	59	57	49
13-24.............	5	40	3	5	36	4	4	4	4	8	5	8
More than 24......	1	17	---	*	16	1	1	---	---	*	---	1
Not ascertained...	*	---	---	1	---	---	4	1	1	2	1	3
Frequency of purchase in the past 4 weeks:												
Not at all........	2	3	1	1	1	1	2	4	1	1	3	---
Once..............	12	18	7	5	21	7	7	5	2	3	2	5
Twice.............	15	19	16	15	18	9	5	5	9	8	10	6
3 times...........	7	6	4	5	7	7	5	3	7	4	3	2
4 times...........	50	47	62	56	44	63	59	67	52	53	68	70
5 times-7 times...	5	2	2	5	4	1	4	5	2	6	3	4
8 or more times...	9	5	7	13	4	10	17	10	24	24	11	13
Not ascertained...	*	*	1	---	1	---	1	1	3	1	---	---
Number of respondents........	338	448	120	221	131	68	231	165	123	304	118	96

*Less than 1 percent.

Table 6.--Percentage distribution of buyers' responses to selected questions in each experiment 1/

Survey of consumer preferences for Florida oranges with and without color added

Replies	Cleveland						Philadelphia					
	Color-added			Natural			Color-added			Natural		
	1959	1960	1961	1959	1960	1961	1959	1960	1961	1959	1960	1961
Noticed "other" group of oranges...	55	63	49	48	68	72	55	80	65	58	86	50
Did not notice "other" group of oranges............	44	37	51	51	32	28	43	20	35	40	14	50
Bought "other" kind recently...........	40	17	34	61	56	47	55	53	41	51	31	34
Did not buy "other" kind recently......	57	82	62	35	43	34	37	45	50	43	65	61
If original choice were not available at time of purchase:												
Would buy "others".	82	71	74	86	79	81	86	84	76	74	61	80
Would not buy "others".........	16	29	25	14	21	18	14	16	22	25	35	18
Know color is added to oranges.........	78	81	78	81	87	79	74	71	76	79	84	79
Don't think color is added to oranges............	5	4	---	5	2	---	5	5	2	4	2	1
Don't know..........	16	15	22	14	10	21	20	24	21	17	14	20
Feel color being added is:												
Good..............	35	29	27	9	8	16	28	28	26	15	7	12
Bad...............	26	26	43	49	48	38	27	18	24	48	46	47
Makes no difference.......	36	44	30	42	44	46	41	50	48	34	45	39
Number of respondents........	338	448	120	221	131	68	231	165	123	304	118	96

1/ Percentages do not always add to 100 because answers not applicable to the questions and answers of shoppers who made mixed purchases of both types of oranges have been omitted.

Table 7.--Percentage distribution of buyers' reasons for selection in each experiment 1/

Survey of consumer preferences for Florida oranges with and without color added

Reasons for selecting	Cleveland						Philadelphia					
	Color-added			Natural			Color-added			Natural		
	1959	1960	1961	1959	1960	1961	1959	1960	1961	1959	1960	1961
Looked better, prettier (color) oranges............	38	39	23	1	7	5	25	30	29	4	6	8
Look juicy, are juicy (feel).......	29	22	28	32	27	46	26	28	24	23	21	21
Are sweeter, better flavor, taste......	20	19	12	11	13	7	20	36	9	18	20	8
Looked ripe.........	15	16	28	3	2	2	9	8	17	1	2	6
Color doesn't rub off............	4	---	---	10	1	2	9	---	---	12	1	---
Thin skin, good skin texture.......	2	1	5	5	4	2	10	3	7	5	7	3
Looked fresher, not spoiled not stale looking......	1	4	---	12	9	22	2	1	1	4	3	5
Looked natural, not artificial looking............	1	1	4	3	8	5	1	1	---	4	9	3
They were cheaper...	1	2	---	2	12	---	3	2	---	5	1	2
Habit, used to buying these.......	1	2	2	---	---	---	---	---	2	2	2	6
Fewer spots, blemishes..........	1	3	---	1	2	7	1	---	1	1	---	2
Naturally ripened...	1	---	2	1	---	---	---	---	---	3	6	2
Thin skin shows they are juicy.....	1	*	9	3	1	2	9	4	2	2	3	2
Color associated with orange........	---	4	4	---	1	---	---	3	2	1	1	---
Meaty, firmer, solid..............	---	2	2	4	13	22	---	4	6	1	9	3
Don't like color-added ones, prefer natural only.......	---	---	---	15	25	2	---	---	1	12	14	15
Color added is harmful............	---	---	---	6	1	---	---	---	---	9	5	2
Don't like additives in food in general.........	---	---	---	2	---	---	---	---	---	4	6	---
Just wanted to try them...........	---	---	---	1	1	---	---	3	---	1	1	---
Juice is darker in color...........	---	*	---	---	---	---	---	2	---	---	1	---
Close at hand.......	7	9	16	8	8	17	17	6	20	7	4	24
No particular reason.............	2	3	4	5	6	5	6	4	11	7	3	6
Miscellaneous.......	4	9	12	9	11	27	3	9	7	12	9	3
Not ascertained.....	1	*	---	3	---	---	5	---	2	2	---	5
Number of respondents........	188	282	57	109	89	41	132	132	82	182	102	66

1/ Excludes those shoppers who did not notice the other group of oranges and those who made mixed purchases of both types.

*Less than 1 percent.

Table 8.--Percentage of prepackaged and bulk purchases in each experiment

Survey of consumer preferences for Florida oranges with and without color added

Method of purchase	Cleveland 1/					
	Color-added			Natural		
	1959	1960	1961	1959	1960	1961
Bag..................	79	67	57	75	72	51
Bulk..................	21	31	43	24	27	49
Both..................	---	*	---	---	---	---
Not ascertained........	---	2	---	1	1	---
Number of respondents..	338	448	120	221	131	68

1/ Oranges in Philadelphia experiments offered in bulk only.

*Less than 1 percent.

Table 9.--Analysis of variance, Florida orange sales in pounds, 15 supermarkets in Cleveland, Ohio, November 23 to December 12, 1959

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares..........	4	3,349,058	837,264	4.638
Stores within squares....	10	4,458,981	445,898	2.470
Periods within squares...	(10)	15,117,514	---	---
Between periods........	2	14,946,282	7,473,141	41.394
Periods x squares......	8	171,232	21,404	0.119
Treatments within squares...............	(10)	3,260,044	---	---
Between treatments.....	2	2,422,653	1,211,326	1/6.71
Treatments x squares...	8	837,391	104,674	0.580
Error....................	10	1,805,348	180,535	---

1/ This mean square with 2 degrees of freedom tested against the error mean square with 10 degrees of freedom is significant at the 5-percent probability level.

Table 10.--Analysis of variance, Florida orange sales in pounds, 15 supermarkets in Cleveland, Ohio, November 14 to December 3, 1960

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	4	1,221,070	305,267	6.35
Stores within squares	10	2,751,109	275,110	5.73
Periods within squares	(10)	1,017,216	---	---
Between periods	2	536,666	268,333	5.59
Periods x squares	8	480,550	60,068	1.25
Treatments within squares	(10)	1,062,314	---	---
Between treatments	2	788,427	394,213	1/8.21
Treatments x squares	8	273,887	34,235	0.71
Error	10	480,367	48,036	---

1/ This mean square with 2 degrees of freedom tested against the error mean square with 10 degrees of freedom is significant at the 1-percent probability level.

Table 11.--Analysis of variance, Florida orange sales in pounds, 15 supermarkets in Cleveland, Ohio, June 12 to July 3, 1961

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	4	79,967	19,992	14.42
Stores within squares	10	87,414	8,741	6.31
Periods within squares	(10)	23,392	---	---
Between periods	2	3,009	1,504	1.09
Periods x squares	8	20,383	2,548	1.84
Treatments within squares	(10)	123,122	---	---
Between treatments	2	88,160	44,080	1/31.804
Treatments x squares	8	34,962	4,370	3.15
Error	10	13,863	1,386	---

1/ This mean square with 2 degrees of freedom tested against the error mean square with 10 degrees of freedom is significant at the 1-percent probability level.

Table 12.--Analysis of variance, Florida orange sales in pounds, 9 supermarkets in Philadelphia, Pa., December 7 to December 26, 1959

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	2	16,721,700	8,360,850	49.17
Stores within squares	6	2,880,984	480,164	2.82
Periods within squares	(6)	217,161	---	---
Between periods	2	147,374	73,687	0.43
Periods x squares	4	69,787	17,447	0.10
Treatments within squares	(6)	2,336,905	---	---
Between treatments	2	1,905,271	952,636	1/5.60
Treatments x squares	4	431,634	107,908	0.64
Error	6	1,020,326	170,054	---

1/ This mean square with 2 degrees of freedom tested against error mean square with 6 degrees of freedom is significant at the 5-percent probability level.

Table 13.--Analysis of variance, Florida orange sales in pounds, 6 supermarkets in Philadelphia, Pa., November 15 to November 22 and November 29 to December 13, 1960

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	1	401	401	0.006
Stores within squares	4	1,618,328	404,582	6.25
Periods within squares	(4)	131,645	---	---
Between periods	2	26,758	13,379	0.21
Periods x squares	2	104,887	52,443	0.81
Treatments within squares	(4)	691,078	---	---
Between treatments	2	561,558	280,779	1/4.34
Treatments x squares	2	129,520	64,760	1.00
Error	4	258,911	64,727	---

1/ This mean square with 2 degrees of freedom tested against error mean square with 4 degrees of freedom is significant at the 10-percent probability level.

Table 14.--Analysis of variance, Florida orange sales in pounds, 6 supermarkets in Philadelphia, Pa., June 13 to July 3, 1961

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	1	708,049	708,049	96.46
Stores within squares	4	794,578	198,644	27.06
Periods within squares	(4)	564,828	---	---
Between periods	2	549,219	274,609	37.41
Periods x squares	2	15,609	7,804	1.06
Treatments within squares	(4)	99,995	---	---
Between treatments	2	1,336	668	1/0.09
Treatments x squares	2	98,659	49,329	6.72
Error	4	29,361	7,340	---

1/ This mean square with 2 degrees of freedom tested against the error mean square with 4 degrees of freedom is not significant at an acceptable probability level.

Table 15.--Combined analysis of variance, Florida orange sales in pounds, 15 supermarkets in Cleveland, Ohio, 1959, 1960, and 1961

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares within experiments	(14)	24,996,081	1,785,435	23.53
Experiments	2	20,345,986	10,172,993	134.08
Squares	4	3,260,658	815,164	10.74
Experiments x squares	8	1,389,437	173,679	2.29
Periods within squares within experiments	30	16,158,121	538,604	7.10
Stores within squares within experiments	30	7,297,503	243,250	3.20
Treatments	2	2,344,302	1,172,151	1/15.45
Treatments x experiments	4	954,937	238,734	2/3.11
Error 3/	54	3,445,821	63,812	---

1/ Significant at the 1-percent probability level.
2/ Significant at the 5-percent probability level.
3/ The following interactions were not found to be statistically significant at an acceptable probability level and were pooled with error: treatments x squares x experiments.

Table 16.--Combined analysis of variance, Florida orange sales in pounds, 6 supermarkets in Philadelphia, Pa., 1959, 1960, and 1961

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares within experiments	(5)	7,818,665	1,563,733	24.30
Experiments	2	7,086,305	3,543,152	55.07
Squares	1	166,555	166,555	2.59
Experiments x squares	2	565,805	282,902	4.39
Periods within squares within experiments	12	774,684	64,557	1.00
Stores within squares within experiments	12	3,000,340	250,028	3.89
Treatments	2	936,933	468,466	[1] 7.28
Treatments x experiments	4	472,656	118,164	[2] 2.30
Error [3]	18	942,786	52,377	---

[1] Significant at the 1-percent probability level.

[2] Significant at the 10-percent probability level.

[3] The following interactions were not found to be statistically significant at an acceptable probability level and were pooled with error: treatments x squares x experiments.

Table 17.--Analysis of variance, grapefruit sales in pounds, 15 supermarkets in Cleveland, Ohio, November 23 to December 14, 1959 [1]

Source of variation	Degrees of freedom	Sums of squares	Mean square	F ratio
Between squares	4	1,076,691	269,173	2.10
Stores within squares	10	3,425,199	342,519	2.678
Periods within squares	(10)	5,139,731	---	---
Between periods	2	4,484,240	2,242,120	17.53
Periods x squares	8	655,491	81,936	0.64
Treatments within squares	(10)	2,286,929	---	---
Between treatments	2	248,815	124,407	[2] 0.97
Treatments x squares	8	2,038,114	254,764	1.99
Error	10	1,278,807	127,880	---

[1] Similar analyses were performed for all other substitute products and similar results were obtained.

[2] Not significant at an acceptable probability level.

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